Saskatchewan Ministry of Agriculture

FINAL REPORT

RESEARCH

ADF

AGRICULTURE DEVELOPMENT FUND

20070081

DEVELOPMENT OF DIETS FOR LOW BIRTH-WEIGHT PIGLETS WHICH OPTIMIZE NET RETURNS TO THE PRODUCER

Funded by: The Agriculture Development Fund

March 2011

Prepared by: Prairie Swine Centre, Inc.

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Development of diets for low birth-weight piglets which optimize net returns to the producer

Project # 20070081

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■ ABSTRACT

Variability in growth is a cost to commercial pork production. Weaning diets, which are expensive, are designed to aid the adaptation from sows milk to solid feed and may disproportionately improve the growth of light-weight piglets, and thus reduce variation in body weight. The feed, however most be consumed, and it takes some piglets more than 24 hours commence consumption of solid food. The overall objective of this experiment was to optimize the diet regime fed to piglets immediately post-weaning for greatest overall net return. We focused on issues of adaptation to the solid feed.

There were 3 dietary treatment regimes, 2 weight group treatments and creep or non-creep fed in the farrowing room. The treatments use two diets: simple and complex and were offered as A: Complex diet day 0 – 1, simple diet, day 2-14, B: Complex diet day 0 – 4, simple diet day 5-14, C: Simple diet day 0 – 14. Individual body weight and feed intake was determined on day 0, 2, 4, 7 and 14. Pens were video-recorded for the 24 hours following a feeding change and viewed to quantify feeder visits. An economic analysis was conducted using current (Nov. 2010) ingredient prices.

All piglets lost weight over the first 24 hours, those continuously on the simple diet (C) lost more ($P = 0.07$ BW, $P = 0.02$ ADG). By day 14 weight was comparable regardless of treatment ($P > 0.05$). Piglets not receiving the complex diet (treatment C) had reduced feed intake compared to those receiving the complex diet for either 1 or 4 days ($P < 0.05$).

Light piglets weighed almost 4 kgs (or 40 %) less than their heavier littermates on day 0 ($P < 0.0001$) and 25% less on day 14 ($P < 0.0001$). Daily gain of the light weight piglets was greater than their heavier litter-mates throughout the trial ($P < 0.0001$).

Piglets receiving creep feed in the farrowing room for one week prior to weaning were about 130 grams heavier at weaning ($P = 0.35$). Piglets who hadn't received creep in the farrowing room had more feeder visits during the first 2 days in the nursery ($P < 0.04$), however, visits were comparable by day 4. Light weight piglets tended to visit the feeder more than their heavier littermates during the initial 48 hours ($P < 0.10$) and significantly more on days 4 or 5 (following the diet change). Piglets "visited" the feeder more when the feeder contained the complex diet ($P < 0.05$).

The complex diet was about $400 more per tonne and since the pigs performed comparable on the various feeding regimes, feeding a simple diet could save $0.35 to 0.40 per piglet.

In conclusion, in a non-competitive environment, light-weight piglets can perform equal to their heavier litter-mates. This indicates that environmental factors (feeder access) need to be examined to improve the poor performance of these piglets. This could have an important impact on the variability in growth.

Feeding creep in the farrowing room was not beneficial. A complex diet containing animal by-products is not necessarily required to maintain performance if the piglets are of good-health and in a non-competitive environment. Although the complex diet cost is not great ($0.35 to 0.40 per piglet) removing animal-by-products from the diet provides producers with important options in diet formulation.

INTRODUCTION

Variability in body weight and growth is a major concern for commercial pork production, especially those who utilize all-in-all-out production systems. Variability in body weight is evident at birth. In a recent study at PSCI, average birth weight was about 1.4 kg, however birth weight ranged from 0.40 kg to 2.50 kg. If we define light birthweight piglets as those 1.5 standard deviations below the mean birthweight and assuming a Saskatchewan sow herd of 100,000 this means 110,000 small birth weight piglets born in Saskatchewan alone. The smaller birth weight piglets in our study failed to demonstrate any evidence of compensatory growth, and their rate of gain lagged behind their larger cohorts throughout all stages of growth, resulting in an additional 10 days to reach market weight. In another study conducted at PSCI it was estimated that increasing days to market by just one day cost the producer 2 $ for every pig sold at the later date. It is clear that the smaller birth weight piglets, and their lag in growth, represent a very large cost to the industry.

Some research has suggested that variability at birth may be tempered with better nutrition shortly following weaning, allowing the very small piglets to "catch up". Work at PSCI has demonstrated that feeding a very high quality diet immediately after weaning, improved the growth of all piglets, and had only moderate effects on decreasing the variability in body weight. The development of phase 1 diets, those diets fed immediately following weaning, is a continual challenge. Producers are striving to decrease costs, improve performance, reduce variability and reduce antibiotic usage. Diets fed to piglets immediately following weaning are designed to safely transition the piglet from the liquid based milk diet to a solids diet. They are typically very complex and costly. Because of the cost, it may be necessary to compromise the growth of the very-low birth weight piglets and feed a phase 1 diet, that provides optimal growth to the average, not the lightest piglets. Moreover, economics may dictate that "optimal" growth, or growth which provides the greatest net return, is not fastest growth for piglets of all body weights.

HYPOTHESIS AND OBJECTIVES

The overall objective of this series of experiments is optimize the diets fed to piglets immediately following weaning for greatest overall net return

Specific objectives include:

1. Develop a simpler (cheaper) phase 1 diet which maintains growth for the heavier piglets within a litter.
2. Develop a phase 1 diet which improves growth and survivability for the very light birth weight piglets.
3. Determine a weight "cut-off" for optimal growth with these phase 1 diet
4. Use economic modelling to determine phase 1 diet cost efficiencies, and at what weight categories it is optimal to feed a cheaper phase 1 diet.

MATERIALS AND METHODS

Animal selection and care. There have been two changes to the original proposal. In both cases this has meant an increase in the work-load to complete the experiment, but was justified to better fulfill the original objectives. One of the parameters we wished to measure was the initiation of feed intake following weaning. Following consultation with others who have attempted the marker method we decided the results would be too variable for our objectives. Moreover it would provide us with only pen, not individual pig data and although we have permission from CFIA to use the markers, our CQA program doesn't approve of them, and it limits our ability to market these pigs. We therefore decided to use video-recording. The piglets are individually marked and thus we can determine feeding behaviour of the individuals. This method also allows us to monitor the performance of the pigs, including antagonistic behaviours which may interfere with feeding.

An informal survey conducted by PSCI during the summer of 2007 suggested that the industry is moving from a 21 to a 28-day or longer weaning period. Because creep feeding was typical when this later weaning age was used several years ago, we decided to incorporate the effect of creep-feeding into our experiment. Creep feeding (providing feed to the piglets when they are still nursing) is assumed to aid in the transition to solid food and is thought to be important when piglets are weaned at a later age. However, there is little work to substantiate this, and we felt that our experiment provided an ideal opportunity to examine the role and/or necessity of providing creep feed. This essentially has required conducting the experiment twice, once with and once without creep. Since this proposal was submitted, our barn has moved from a 21 to a 28 day weaning period with creep feeding.

Each week's farrowing group was used to fill a nursery. (Weeks were not necessarily consecutive as other experiments were allowed to begin). Nurseries have 16 pens, however they were divided to 32 pens for the duration of the experiment. Each pen held 4 piglets. Within each nursery there were 6 pens of "light" piglets and 6 pens of "heavy" piglets. The weights to define each group were set with the initial weaning groups. Each week the entire weaning group was weighed, - pigs were ranked according to weight within gender. Piglets from the heaviest and lightest groups were selected for use on the experiment. Only extremely unthrifty or unhealthy pigs were excluded from the potential pool of pigs. Pens were mixed gender.

Experimental design. This experiment was designed as a randomized complete block with repeated measures for the hourly video recording measurements.. There were 3 dietary regime treatments, plus 2 weight group treatments and creep or non-creep fed in the farrowing room. Thus each nursery had n = 2 pens per treatment. The treatments are the two diets: simple and complex and using a temporal arrangement of diet offerings for the 3 dietary treatments (Table 1). Treatment A: Complex diet for day 0 – 1, simple diet, day 2-14, Treatment B. Complx diet for day 0 – 4, simple diet day 5-14, Treatment C. Simple diet day 0 – 14.

Sample collection. Individual body weight was determined on day 0, 2, 4, 7 and 14. Feed intake was also determined on these days using feeder weighbacks. These weights were taken at the same time of day each week. Celite (0.4 %) was added to a subsample of each diet as a source of acid-insoluble ash to use as a marker for digestibility determinations. These diets wer fed from days 0 to 7 in 3 of the nurseries (36 pens). Fresh faecal samples were collected on days 2 and 6 from these

pens. Feces were lyophilized, ground and analyzed for moisture, energy (bomb calorimetry) and acid-insoluble ash.

Video recording. Pens were equipped with a video camera for recording the feeder approach, defined as a piglet inserting their snout into the feeder. Pens were recorded for the 24 hours following a feeding change (Days 0, 1, and 4 for the first 8 nurseries and days 0, 1 and 5 for the next 7 nurseries). All pens were recorded on each day, even though some treatments (pens) remained on the same treatment but required for comparison.

The cameras were hung in the nursery the day prior to weaning. Each camera was set up to record two pens. Six cameras were thus used in each nursery. A cart containing two time lapse VCR's, two quad splitters (allows the simultaneous screening from 4 cameras) and a monitor were installed in the nursery. Three cameras were connected to each quad, and each quad was connected to a VCR. The monitor was used to ensure correct camera positioning prior to recording.

To accommodate the video-recording, lights remained on 24 hours.

Day 0 video-recording. Care was taken on the first day (day 0) of the experiment to move the piglets from the farrowing room to the nursery in exactly the same way, so that time from weaning, to the initiation of the video-recording was the same each week.

Piglets were initially moved into spare pens in the nursery. They were weighed, and identification and gender was recorded. They were then sorted (on paper) into treatment groups and the groups randomly assigned to a pen. The pigs were then moved into the assigned pens. Each piglet within a pen was numbered using a large marker to allow identification during the video-recording. The cart containing the recording equipment was then moved into the room, and the equipment was quickly checked. The VCR's were turned on and immediately each pen was given a pre-weighed allotment of their treatment diet. Thus time 0, means piglets are in the pen and they have received feed.

Statistical analysis. Treatments were arranged as a 2 x 2 x 3 (creep x weaning weight x treatment regime) factorial. The experiment was analyzed as a split plot, with creep as the main plot, and nursery and pens within nursery as sub-plots.

The feeder visit data was analyzed using repeated measures. Because of the presence of missing data, hour was considered a classification, but modelled as a continuous variable (dummy variable) in the model (Littell et al. 2002). The appropriate covariance structure (autoregressive or compound symmetry) was chosen using the fit statistics of SAS. Performance data is reported as means, the feeder visit data as least-square means. When the SEM varied between means the largest was reported.

When the feeder visit data was graphed a diurnal pattern in behaviour became very apparent. Moreover, in several instances, the hour by visit interaction was significant. Rather than separating the data out by individual hours it was decided to divide the data into an "active" and a "resting" phase. The active phase is hours 1-6 and 18 to 24 inclusive and the resting phase hours 7 to 17 inclusive. Hour 1 is hour 0 to 1 post feeding (typically about 9:30 to 10:30 AM). Hour was modelled as a repeated measure within each phase.

All statistical analyses used Proc Mixed of SAS (v. 9.2).

Economic analysis. Diets were priced according to current commercial ingredient costs.

■ RESULTS and DISCUSSION

Diets. Diets and the analyzed nutrient composition are shown in Table 1. The goal of diet formulation was to feed diets which met energy, protein (amino acid), and all mineral and vitamin requirements of the piglets, yet varied in cost. The complex diet contained plasma, blood meal and whey, ingredients which have been shown to be beneficial in the growth of the young piglet, but probably through other mechanisms than nutrient provision. This goal was met, as the nutrient composition was similar, yet diet cost varied by almost $400 per tonne (November 2010 prices). Diets were formulated to be equal in essential amino acids, and although we didn't analyze the diets for amino acid content, the comparable crude protein concentrations provides evidence that the protein sources used contained the expected protein content, and thus we have confidence that amino acid levels between the two diets were comparable.

Performance. Table 3 provides data on the effect of diet and dietary regime on the performance of the growing pig. Only the main effects of diet are shown, thus averaged across all nurseries and weaning weight groups. As per experimental design, body weight at weaning (day 0) was equal across treatments. All piglets lost weight over the first 24 hours, those on the simple diet (treatment C) lost significantly more ($P = 0.07$ BW, $P = 0.02$ ADG). Over the next 7 days, the piglets on treatment B (complex diet for 4 days, then simple) maintained a heavier body weight. However, by day 14 (all piglets on the simple diet from days 5 to 14) body weight was comparable ($P = 0.14$, Table 3). Body weight gain was negatively affected by diet change as can be seen in the poor performance of the piglets on diet B from days 5 to 7. Treatment effects on gain are not completely explained by changes in feed intake (disappearance). Piglets not receiving the complex diet (treatment C) had reduced feed intake from day 0. Piglets on treatment B consumed more feed on days 5 to 7 (following their diet change) than other group A or group C piglets. This is interesting as all piglets on this time are on the simple diet. Day 8 to 14 feed intake was comparable among treatments ($P = 0.72$) thus provision of the complex diet did not have an effect on feed intake that was maintained.

Feed efficiency day 0 to 1, is negative, indicating that despite some feed intake the piglets lost weight. This could be due to water loss, or perhaps feed wastage and as indicated by the high SEM is extremely variable between piglets. The SEM for feed efficiency includes variability associated with both body weight and feed intake. The feed efficiency of piglets on treatment A, days 2-4 was close to 0, reflecting their poor gain after the change to the simple diet on day 2. Similarly, the feed efficiency of the piglets on treatment B is poor following their diet change on day 4. Regardless, overall (day 0 to 14) feed efficiency is comparable (FCE = 0.70, $P = 0.31$, Table 3).

Table 4 shows the effect of weaning weight (body weight), presence of creep feed in the farrowing room and the interactions on performance. Light piglets weighed almost 4 kgs (or 40 %) less than their heavier littermates ($P < 0.0001$). A difference is still observed by day 14 ($P < 0.0001$), however, the light weight piglets are now only about 25 % lighter. Surprisingly, average daily gain of the light weight piglets was greater than their heavier litter-mates throughout the trial ($P < 0.0001$). They

lost less weight, day 0 to 1, and experienced a greater rate of gain day 2 to 14. Although significant, the difference is only about 30 grams per pig per day, however, if expressed relative to body size it is quite a remarkable difference. We don't have a good explanation for this, food intake was comparable ($P > 0.05$) thus the lighter weight pigs were more efficient ($P < 0.0001$). It should be noted that these piglets were penned, 4 to a pen, and each pen contained piglets of similar body weight. The heavier piglets were perhaps more aggressive and expended energy fighting, or running around the pen. Regardless, it indicates that feed intake, if in a non-competitive environment is not a problem for these light-weight piglets.

Piglets receiving creep feed in the farrowing room for one week prior to weaning were about 130 grams heavier at weaning ($P = 0.35$). This does not approach significance, and thus for the piglets selected for the experiment, feeding creep had no effect on weaning weight. Because we selected piglets for this experiment (the heavies and lightest in the farrowing group) we may have biased this outcome. When all piglets in the farrowing groups were included however, the positive effect due to creep feed was only 150 grams per pig (data not shown). Since we saw less of an effect by day 14 on body weight, and no effect on growth or feed intake, we conclude that in our facility feeding creep in the farrowing room is not beneficial. In fact, feed efficiency was actually slightly better ($P < 0.05$) overall in piglets not receiving creep. The large difference in feed efficiency day 5 to 7 ($P < 0.001$) is not maintained, and appears to be an artefact of calculating a ratio.

Surprisingly, there were few interactions. The creep by body weight interaction seen at the beginning of the trial ($P < 0.05$, Table 4) is apparently due to very minor changes in body weight and probably irrelevant (data not shown). We found very few interactions of diet with either creep feed or body weight. We had hypothesized that light weight pigs would respond more to a complex diet than pigs which were heavier at weaning. This would show up as a weaning weight by diet treatment interaction, which was not seen ($P > 0.05$, Table 4.) except day 0 to 1 (BW by diet, $P = 0.01$ ADG, $P = 0.03$, ADFI. Lightweight piglets did poorer on the simple diet (treatment C) relative to those receiving the complex diets. In contrast, piglets which were heavier at weaning, lost weight regardless of whether they received a simple or complex diet (Figure 1).

Dry matter and gross energy digestibility of the complex diet on day 2 was 66 and 61 % respectively (data not shown) We were unable to determine digestibility for the simple diet during this sampling period. Values ranged from highly negative digestibility to about 60 %. We don't have a good explanation for this, but it may be due to the highly variable and low feed intake of the piglets on this diet during the first 24 hours. Digestibility of this diet by day 6 was about 84 % for both dry matter and gross energy digestibility. However, due to the rapid development of the piglets gastrointestinal tract during this time, this is not a good comparison with the determination on day 2.

Figures 2, 3 and 4 describe the effect of creep feed, body weight and treatment regime on "feeder visits" over 24 hours beginning on day 0, 1 or 4 (or 5). A feeder visit is defined as a piglet approaching the feeder and putting his snout into the feeder tray. Appropriate data and statistics are shown in Tables following each series of graphs. It is readily apparent from all the graphs that, despite lights being on continuously, the piglets display a marked diurnal rhythm in their activity. They were active for about 6 hours post-weaning, rested for about 10 hours, then active throughout the day. These nursery rooms are isolated from the rest of the barn, thus noise or activity outside the rooms doesn't explain this pattern. Because of this pattern, we analyzed the data as a repeated

measures over the 24 hour period, and also as repeated measures within an "active" and a "resting" phase.

Piglets who hadn't received creep in the farrowing room had more feeder visits during the first 2 days in the nursery ($P < 0.04$), however, they were comparable by day 4 or 5. There was a significant hour by creep interaction, due to the fact that the difference was greater (although small) during the resting phase ($P < 0.0001$, Table 5b). We had hypothesized that feeding creep in the nursery would familiarize piglets with solid feed and thus they would approach the feeder more, especially during the first 24 hours. This does not appear to be the case.

Light weight piglets tended to visit the feeder more than their heavier littermates during day the initial 48 hours ($P < 0.10$) and significantly more on days 4 or 5 (following the diet change). The numbers were more variable during the first 48 hours of videotaping. The hour by weight interaction (Table 5b) shows that this difference is entirely due to these piglets approaching the feeder more during the "active" phase of their cycle ($P < 0.01$). As indicated by the feed intake, at least over the initial 24 hours, these feeder visits did result in increased feed consumption.
Piglets "visited" the feeder more when the feeder contained the complex diet. This was significant following the diet change on day 1 when only treatment B piglets are now receiving the complex diet ($P < 0.04$, Table 7a). It is interesting that the difference is still observed on day 4/5, when all are receiving the simple diet ($P < 0.05$). This is due to differences during the active phase (Table 7b). The weaning weight by treatment interaction on days 0 to 1 for feeder visits is shown in Figure 5. The difference between the treatments is greater in the light weight pigs.

Economics. The difference in price between the complex and simple diet is marked, about $400 per tonne. The piglets in this experiment performed comparable during the first 14 days in the nursery regardless of treatment regime. These piglets are consuming very small amounts of feed, however, savings could amount to $0.35 to $0.40 per piglet, if excluding the complex diet from the feeding regime.

■ CONCLUSIONS and IMPLICATIONS

Our experiment demonstrates that in a non-competitive environment light-weight piglets will perform equally well to their heavier littermates. This indicates that poor growth of the light-weight piglets is due more to environmental (perhaps a failure to compete) than feed factors. The lightweight piglets actually consumed more feed and had more feeder visits immediately post-weaning than their heavier littermates.

Feeding creep in the farrowing room, for the 1 week prior to weaning (28 day weaning) was not beneficial. Piglets were slightly heavier, but this was difference was lost by day 14 in the nursery.

This experiment shows that a "complex" diet containing animal by-products is not necessarily required to maintain performance if the piglets are of good-health and not in a competitive environment. The savings would be $0.35 to $0.40 cents per piglet, regardless of body weight. Perhaps more importantedly, this provides options for producers who may wish to remove animal by-products from their diets. We didn't see the expected differences to dietary regime resulting from weaning weight. The light-weight piglets performed comparable to their heavier litter-mates regardless of treatment. Thus cost saving may accrue from feeding all piglets a cheaper diet. Nursery diets, or regime, will not reduce variability body-weight variability at nursery exit.

Table 1. Experimental diets [a]

Ingredient, %	Simple	Complex
Wheat	29.860	24.201
Soymeal	25.000	16.900
Peas	10.000	10.000
Canola meal	7.800	
Corn		20.000
Corn DDGS	20.000	
SD Whey		14.286
SD Plasma		2.500
SD Blood meal		2.500
Menhaden fishmeal		5.000
Canola oil	2.800	1.753
Limestone	0.850	0.700
Monodicalcium phosphate	1.150	0.150
PSCI Vitamins	0.600	0.600
PSCI minerals	0.600	0.600
Salt	0.400	0.250
Lysine HCl	0.385	0.020
L-threonine	0.245	0.190
DL methionine	0.090	0.130
LS20	0.100	0.100
Choline chloride	0.080	0.080
CuSO4*5H2O	0.040	0.040
Analyzed nutrient content, %		
Moisture	11.74	11.92
Crude protein	25.45	25.35
Crude fibre	5.51	4.46
ADF	6.35	4.00
NDF	13.52	11.67
Crude fat	6.17	4.33
Ca	0.92	0.93
P	0.78	0.68
Mg	0.26	0.20
K	1.03	0.99
Na	0.19	0.33

[a]Celite (0.4 %) was added to 50 kgs of each diet to be used as a marker for the determination of diet digestibility.

Table 2. Dietary Treatments

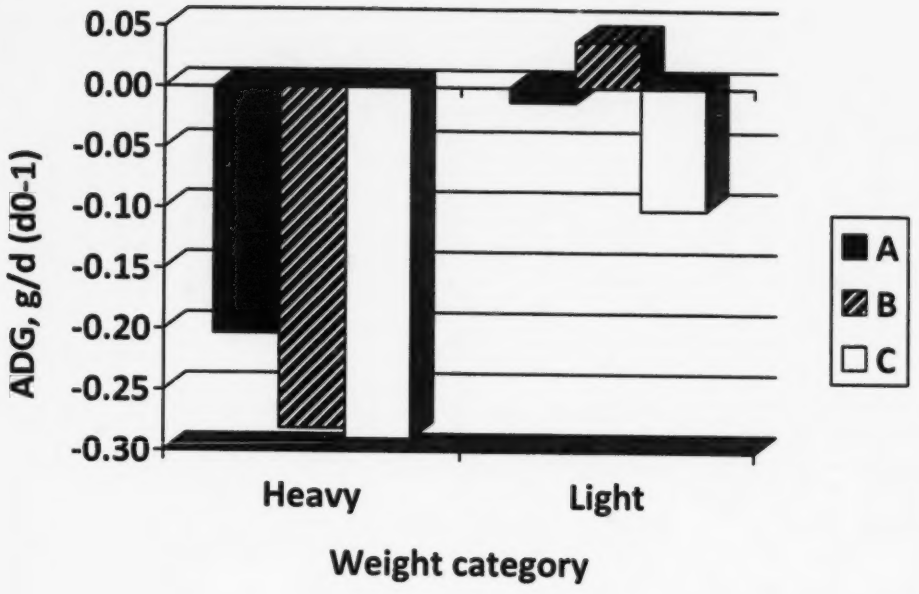
Treatment	Feeding Procedure
A	Complex diet Day 0-1, Simple diet Day 2-14
B	Complex diet Day 0-4, Simple diet Day 5-14, or complex day 0 to 5 for 7 nurseries
C	Simple diet Day 0-14

Table 3. The effect of dietary treatment on growth and feed intake.

		Dietary Treatment				
Parameter		A	B	C	SEM	P value
Body wt, kg	Day 0	8.43	8.43	8.41	0.07	0.9221
	Day 1	8.32	8.32	8.22	0.08	0.0700
	Day 4	8.45^{b}	8.90^{a}	8.43^{b}	0.08	<0.0001
	Day 7	8.79^{b}	9.18^{a}	8.78^{b}	0.10	<0.0001
	Day 14	10.96	11.25	11.10	0.17	0.1400
ADG, kg/day	Day 0-1	-0.11^{b}	-0.12^{b}	-0.20^{a}	0.02	0.0015
	Day 2-4	0.03^{b}	0.14^{a}	0.06^{b}	0.01	<0.0001
	Day 5-7	0.14	0.13	0.15	0.01	0.2141
	Day 5-14	0.27^{a}	0.25^{b}	0.28^{a}	0.01	0.0421
	Day 8-14	0.31	0.30	0.33	0.01	0.0548
	Day 0-14	0.18	0.20	0.19	0.01	0.1422
ADFI, kg/day	Day 0-1	0.12^{a}	0.12^{a}	0.08^{b}	0.01	0.0017
	Day 2-4	0.10^{b}	0.17^{a}	0.12^{b}	0.01	0.0001
	Day 5-7	0.19^{b}	0.25^{a}	0.20^{b}	0.01	0.0006
	Day 5-14	0.31	0.33	0.31	0.01	0.1635
	Day 8-14	0.35	0.36	0.35	0.01	0.7240
	Day 0-14	0.24	0.27	0.25	0.01	0.0018
Gain/feed	Day 0-1	-2.29	-4.03	-3.74	0.62	0.0761
	Day 2-4	0.02^{c}	0.83^{a}	0.40^{b}	0.12	0.0001
	Day 5-7	0.52^{a}	0.38^{b}	0.53^{a}	0.04	0.0001
	Day 5-14	0.78	0.67	0.81	0.02	0.0001
	Day 8-14	0.90^{a}	0.82^{b}	0.93^{a}	0.02	0.0001
	Day 0-14	0.68	0.68	0.71	0.04	0.3131

Table 4. The effect of weaning weight group on growth, feed intake and feed conversion efficiency.

		Weaning Weight				Creep Feed				P value, Interactions		
		Heavy	Light	SEM	P value	No	Yes	SEM	P value	Creep *BW	Creep*Diet	BW*diet
Wean. wt, kg	Day 0	10.40	6.44	0.07	<0.0001	8.36	8.49	0.10	0.35	0.01	0.96	0.98
	Day 1	10.15	6.42	0.07	<0.0001	8.24	8.33	0.10	0.49	0.02	0.72	0.39
	Day 4	10.42	6.76	0.08	<0.0001	8.56	8.61	0.11	0.75	0.05	0.59	0.69
	Day 7	10.71	7.13	0.10	<0.0001	8.88	8.96	0.14	0.70	0.23	0.59	0.35
	Day 14	12.73	9.48	0.16	<0.0001	11.17	11.04	0.21	0.67	0.85	0.10	0.14
ADG, kg/day	Day 0-1	-0.26	-0.02	0.02	<0.0001	-0.12	-0.16	0.02	0.36	0.79	0.41	0.01
	Day2-4	0.07	0.08	0.00	0.040	0.08	0.07	0.01	0.43	0.60	0.64	0.63
	Day 5-7	0.12	0.15	0.01	0.001	0.16	0.12	0.02	0.11	0.84	0.88	0.88
	Day 8-14	0.29	0.34	0.01	<0.0001	0.33	0.30	0.02	0.20	0.57	0.04	0.13
	Day 0-14	0.16	0.21	0.01	<0.0001	0.20	0.17	0.01	0.05	0.63	0.12	0.15
	Day 5-14	0.25	0.29	0.01	<0.0001	0.29	0.25	0.01	0.03	0.59	0.12	0.13
ADFI, kg/day	Day 0-1	0.09	0.13	0.01	<0.0001	0.12	0.10	0.01	0.10	0.42	0.38	0.03
	Day 2-4	0.13	0.13	0.01	0.14	0.13	0.13	0.01	0.77	0.68	0.74	0.69
	Day 5-7	0.22	0.21	0.01	0.720	0.22	0.21	0.01	0.88	0.80	0.09	0.59
	Day 8-14	0.35	0.35	0.01	0.770	0.37	0.34	0.01	0.16	0.45	0.07	0.14
	Day 0-14	0.25	0.25	0.01	0.830	0.26	0.25	0.01	0.33	0.59	0.16	0.16
	Day 5-14	0.32	0.32	0.01	0.810	0.33	0.30	0.01	0.03	0.42	0.10	0.15
FCE, G/F	Day 0-1	-5.36	-1.34	0.62	<0.0001	-2.51	-4.19	0.59	0.06	0.33	0.69	0.48
	Day 2-4	0.40	0.43	0.10	0.840	0.39	0.44	0.10	0.75	0.21	0.44	0.51
	Day 5-7	0.43	0.52	0.04	0.001	0.70	0.25	0.06	<0.0001	0.11	0.87	0.59
	Day 8-14	0.81	0.96	0.02	<0.0001	0.89	0.88	0.03	0.92	0.47	0.51	0.47
	Day 0-14	0.59	0.79	0.04	<0.0001	0.77	0.61	0.05	0.05	0.56	0.13	0.84
	Day 5-14	0.70	0.81	0.02	<0.0001	0.86	0.65	0.02	<0.0001	0.34	0.19	0.57



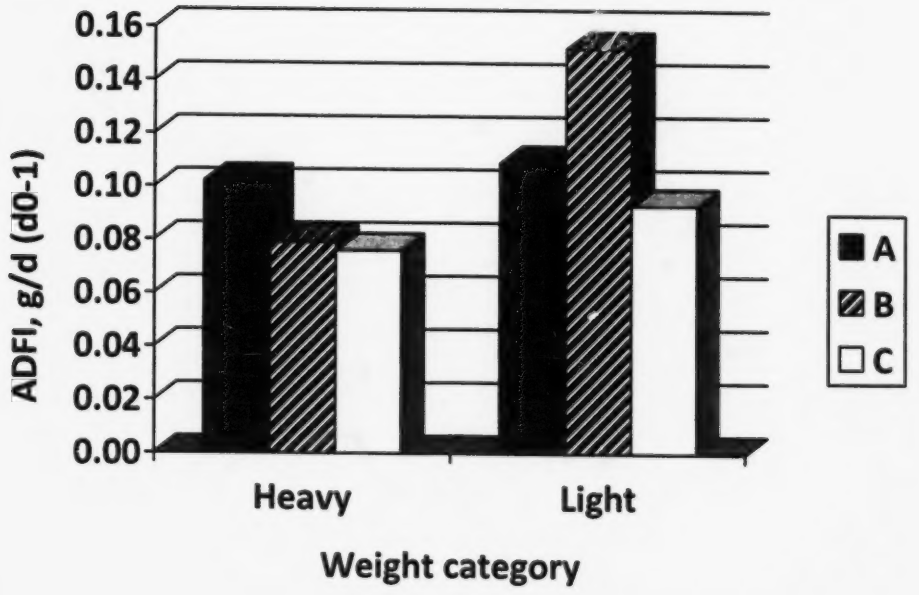
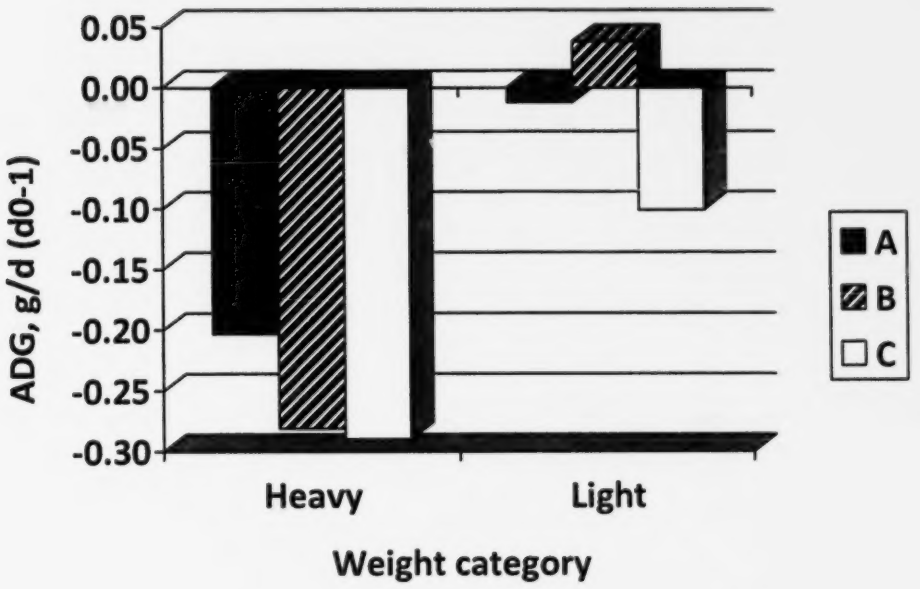
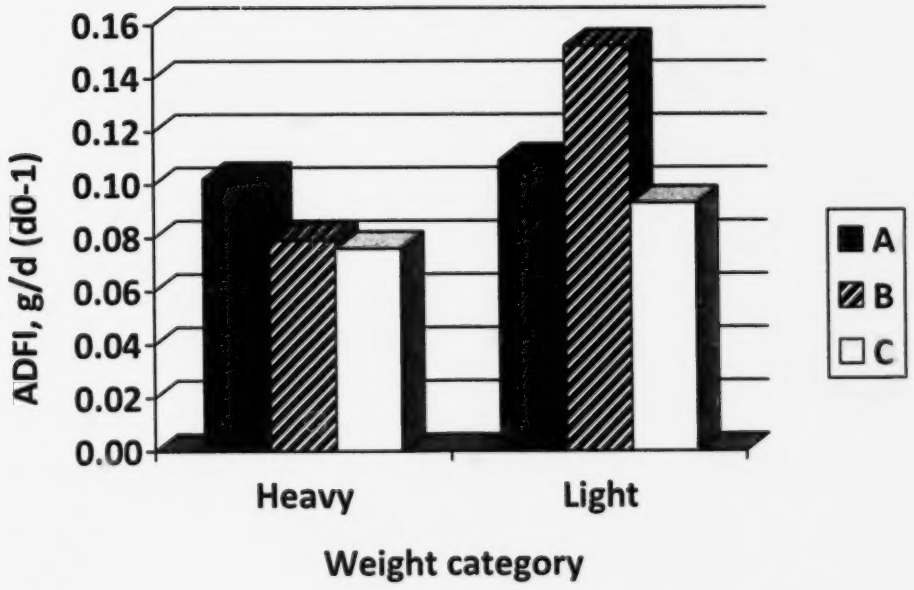


Figure 1. The interaction between weaning weight and feeding regime on the growth and feed intake of piglets day 0 to 1 post-weaning.Treatment A and B piglets were receivng the complex diet and treatment C piglets the simple diet during this period. BW x treatment interaction, $P < 0.01$, ADG, $P < 0.03$, ADFI.





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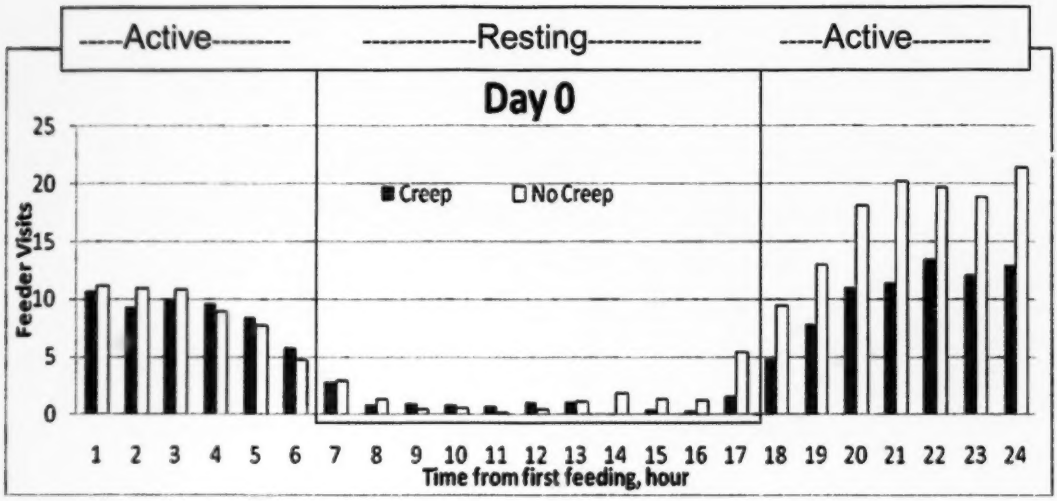


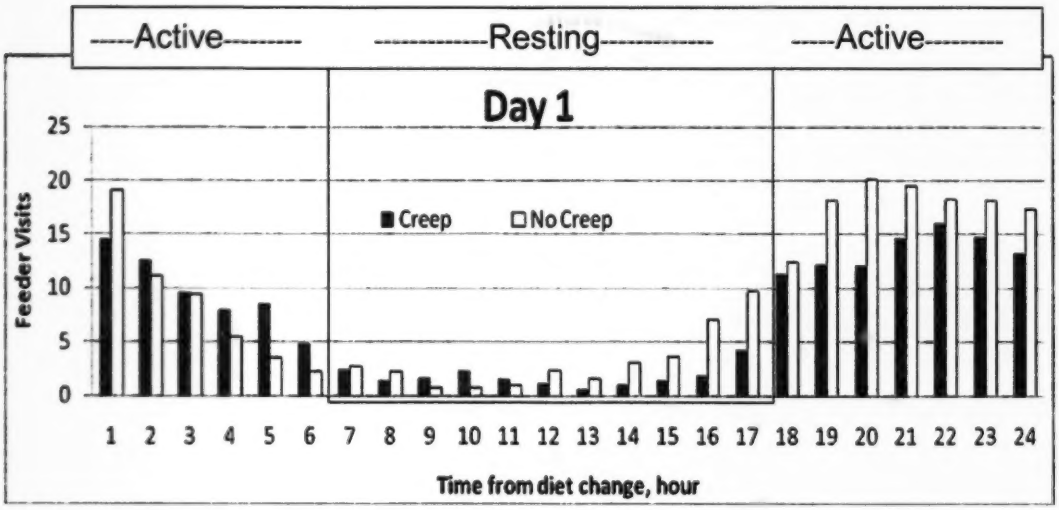


Figure 2. The effect of feeding creep in the farrowing room on feeder visits in the nursery. Day 0, and day 1 post-weaning. The 24 hour period was arbitrarily divided into active and resting phases. Appropriate statistics are described in tables 5 and 6.

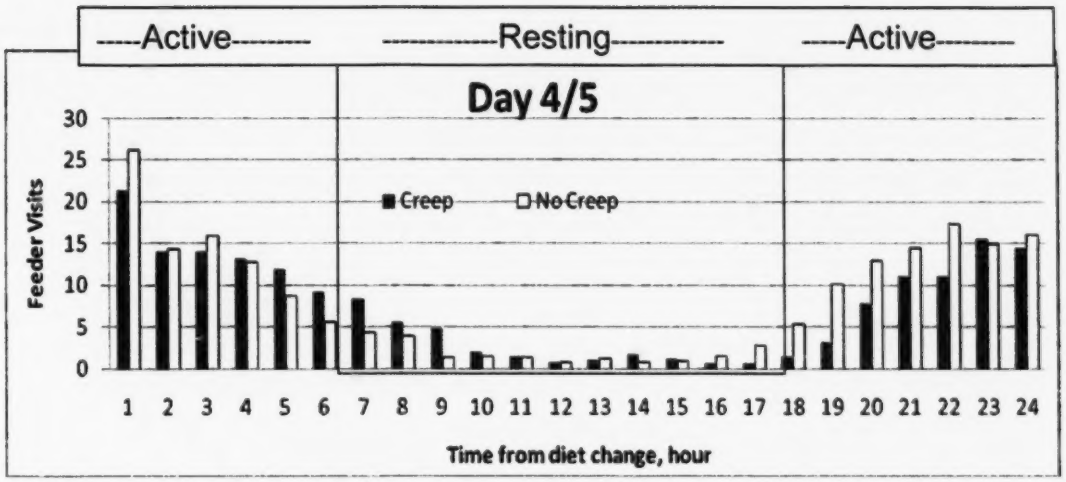


Figure 2 cont.. The effect of feeding creep in the farrowing room on feeder visits in the nursery. Day 4 (or 5) post-weaning. Regardless of whether 4 or 5, it is the day following the diet change for treament B. The 24 hour period was arbitrarily divided into active and resting phases. Appropriate statistics are described in Table 5..

Table 5a. The effect of creep feeding in the farrowing room on feeder visits in the nursery.

	Creep	No creep	SEM	P value
Day 0	6.3	8.6	0.45	0.02*
Day 1	7.0	9.1	0.32	0.04*
Day 4/5	7.4	8.0	0.29	0.12*

Hour by creep, $P < 0.001$

Table 5b. The effect of creep feeding in the farrowing room on feeder visits in the nursery. To investigate the hour by creep interaction, each 24 period was divided into an "active" and a "resting" phase.

	Active				Resting			
	Creep	No creep	SEM	P value	Creep	No Creep	SEM	P value
Day 0	9.95	13.47	0.52	0.31*	1.07	1.62	0.17	0.001*
Day 1	11.52	13.76	0.49	0.30*	1.76	3.10	0.24	<0.0001*
Day 4/5	11.50	13.47	0.49	0.90*	2.55	1.90	0.24	<0.0001*

Hour by creep, $P < 0.0001$

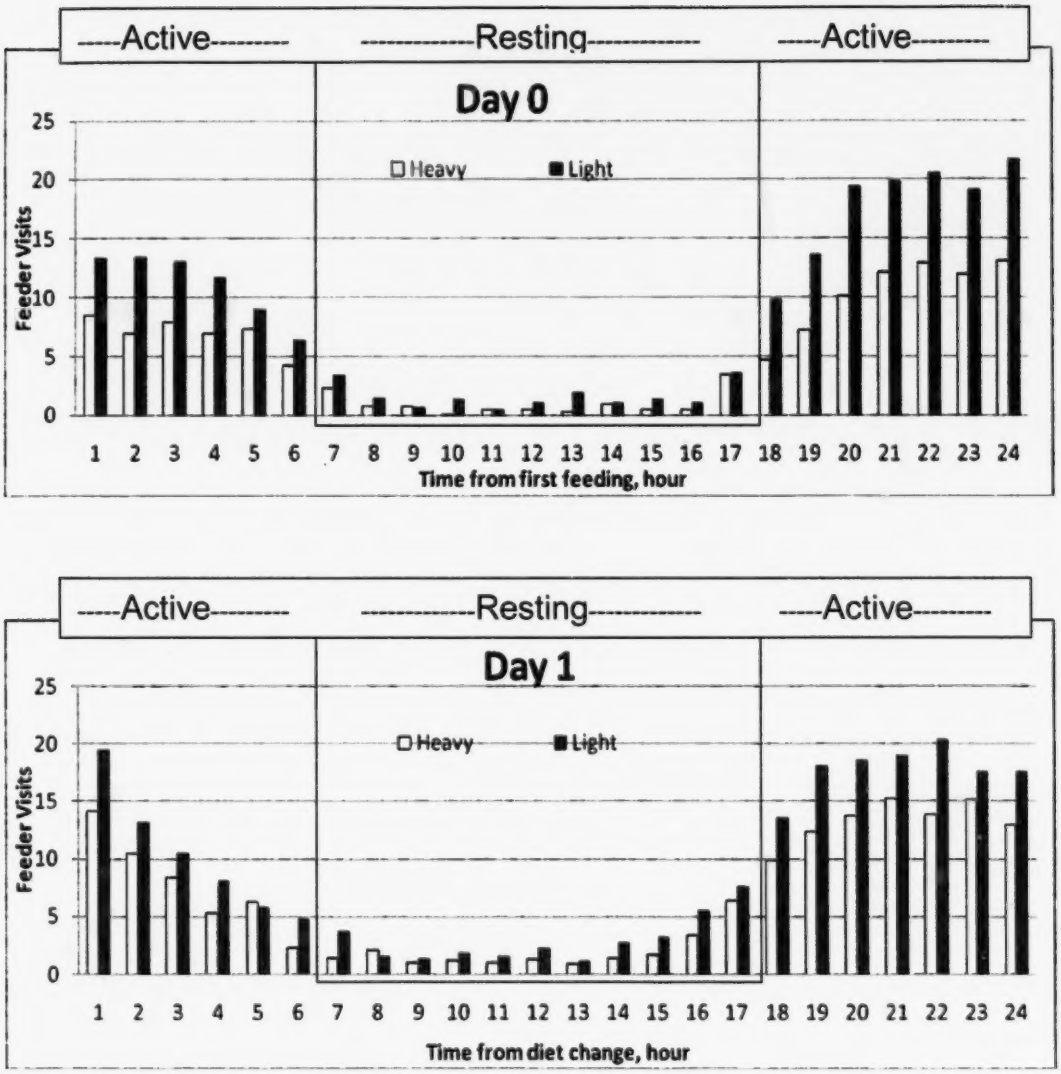


Figure 3. The effect of weaning weight feeder visits. Day 0, and day 1 post-weaning. The 24 hour period was arbitrarily divided into active and resting phases. Appropriate statistics are described in Table 6.

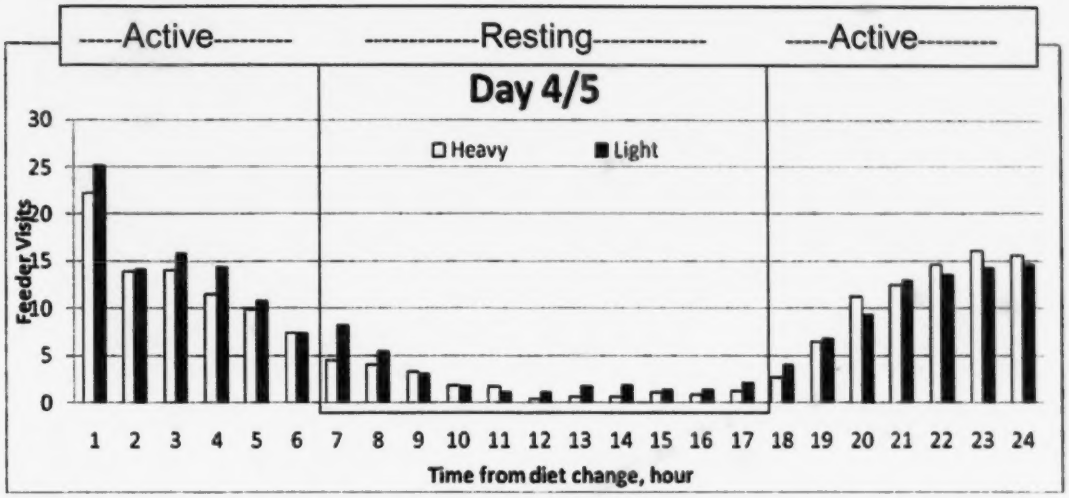


Figure 3 cont.. The effect of wening weight on feeder visits in the nursery. Day 4 (or 5) post-weaning. Regardless of whether day 4 or 5, it is the day following the diet change for treament B. The 24 hour period was arbitrarily divided into active and resting phases. Appropriate statistics are described in Table 6.

Table 6a. The effect of weaning weight on feeder visits .

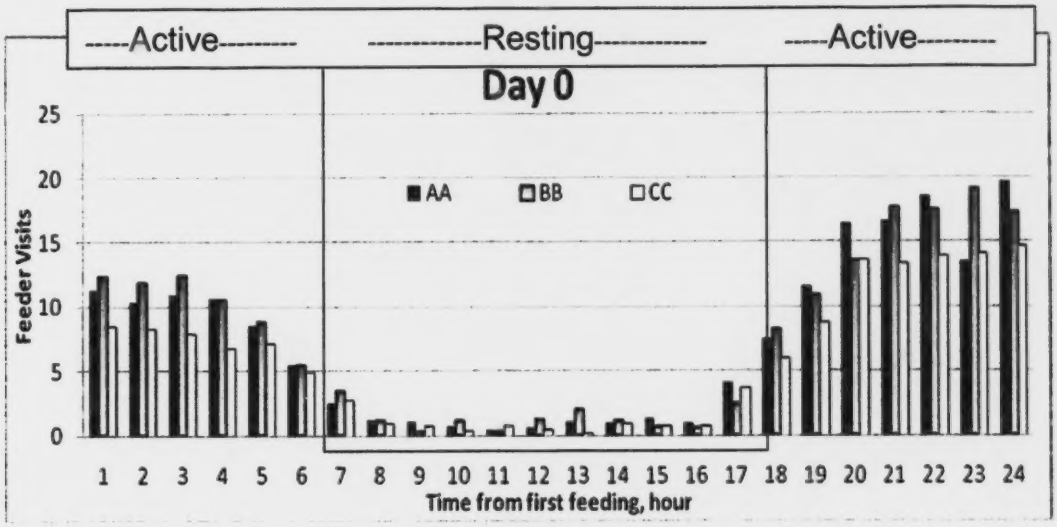
	Heavy	Light	SEM	P value	
				Weight	Hour by weight
Day 0	5.61	9.35	0.44	0.08	0.07*
Day 1	6.83	9.28	0.32	0.10	0.07
Day 4/5	7.37	8.00	0.27	0.007	0.03

*Weaning weight by diet regime, P = 0.05. Illustrated in Figure 7.

Table 5b. The effect of weaning weight on feeder visits. To investigate the hour by creep interaction, each 24 period was divided into an "active" and a "resting" phase.

	Active				Resting			
	Heavy	Light	SEM	P value	Heavy	Light	SEM	P value
Day 0	8.81	14.61	0.49	0.001*	0.98	1.71	0.16	0.21
Day 1	10.86	14.42	0.49	0.01	1.94	2.91	0.24	0.84
Day 4/5	12.24	12.73	0.46	0.05	1.81	2.64	0.23	0.06

*Hour by BW, P < 0.001



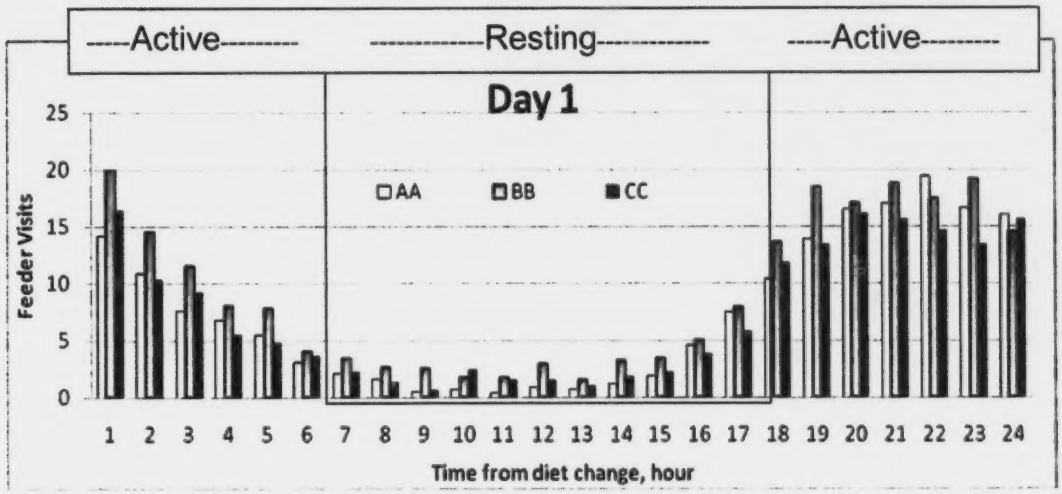


Figure 4. The effect of diet regime (Table 1) on feeder visits. Day 0, and day 1 post-weaning. The 24 hour period was arbitrarily divided into active and resting phases. Appropriate statistics are described in Table 7.

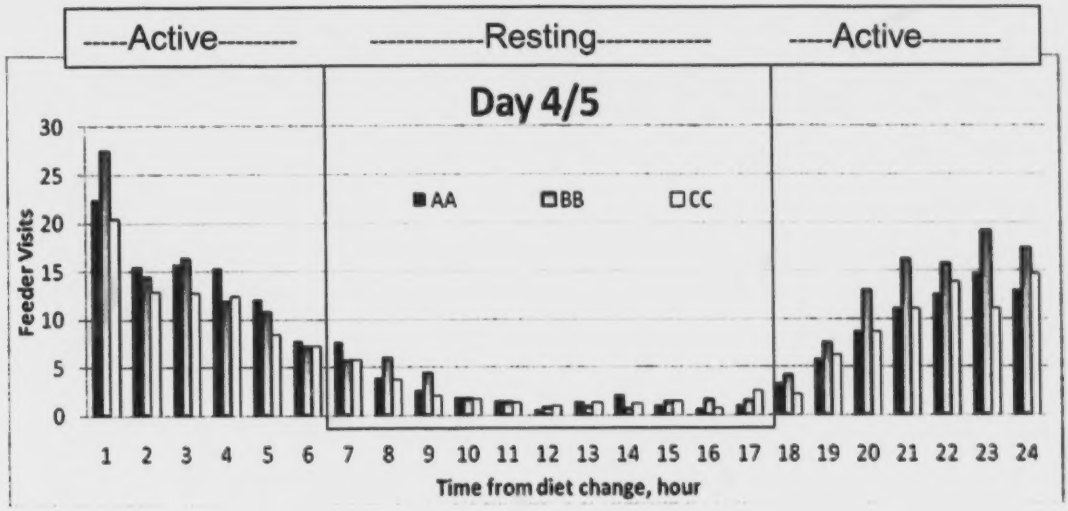


Figure 4 cont.. The effect of diet regime (Table 1) on feeder visits. Day 4 (or 5) post-weaning. Regardless of whether 4 or 5, it is the day following the diet change for treament B. The 24 hour period was arbitrarily divided into active and resting phases. Appropriate statistics are described in Table 7.

Table 7a. The effect of feeding regime (Table 1) on feeder visits .

	A	B	C	SEM	P value	Diet by hour
Day 0	8.13	8.01	6.30	0.55	0.25	0.86
Day 1	7.31	9.43	7.41	0.40	0.004	0.17
Day 4/5	7.71	8.48	6.87	0.35	0.05	0.02

Table 7b. The effect of feeding regime (Table 1) on feeder visit. investigate the hour by creep interaction, each 24 period was divided into an "active" and a "resting" phase.

	Active					Resting				
	A	B	C	SEM	P <	A	B	C	SEM	P <
Day 0	12.55	12.60	9.98	0.52	0.20	1.47	1.40	1.17	0.21	0.33
Day 1	11.94	14.33	11.65	0.60	0.007	1.88	3.23	2.18	0.29	0.28
Day 4/5	12.37	14.08	11.00	0.59	0.06	2.22	2.34	2.11	0.28	0.28

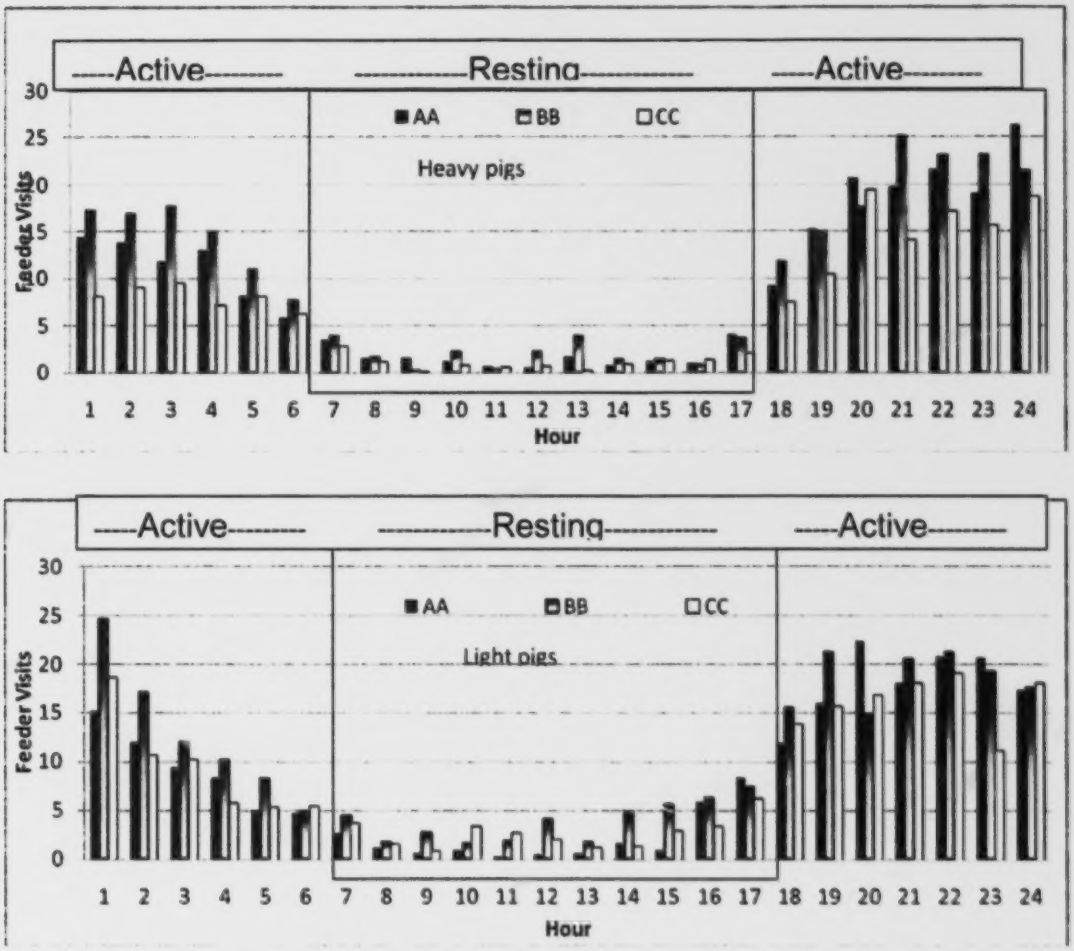


Figure 5. The interaction of diet regime and weaning weight on feeder visits day 0 to 1 (as described in Table 6a.

■ REFERENCES

Littell, R.C., Milliken, G.A., Stroup, W.W. and Wolfinger, R.D. 2006. *SAS®* System for Mixed Models. Cary, NC. SAS Institute Inc.

CONTRIBUTIONS

A manuscript is being prepared with this data for the Canadian Journal of Animal Science.

A portion of this work appears in the Fall/Winter issue of Centred on Swine, the Prairie Swine Centre, newsletter. The observations will be written up for the Spring issue.

An abstract of this work will be presented at the American Society for Animal Science meetings, 2011.

Results of this work appear on the Prairie Swine Centre, Inc. web-site and will be written up for one producer periodical (winter 2011).